On-Site Rule Revision Issue: Residential Sewage Quality vs Nonresidential Sewage Quality

Issue Statement

The Rule Review Committee and some LHJs have brought forward the need to define typical residential waste strength (sewage quality per WAC definition). The intent is to establish specific parameters for $CBOD_5$, TSS, and O&G. This will simplify the design and review process for non-residential proposals while ensuring public health and the environment are protected.

WAC 246-272A-0020(1) currently requires the local health officer to apply the chapter to OSS treating sewage and dispersing effluent from **residential** sources, and allows them to apply the chapter to OSS for **nonresidential** sources of sewage **if** treatment, siting, design, installation, and operation and maintenance measures provide treatment and effluent dispersal that results in treated sewage equal to that required of residential sources.

WAC 246-272A-0230(2) (e), (i) (A) and (ii) (B&C) currently require the designer to address sewage quality for all OSS, considering $CBOD_5$, TSS and O&G (common sewage quality parameters). And if not a residential source, the designer must provide information regarding the sewage quality not typically found in sewage from a residential source, and design to a treatment level equal to sewage from a residential source. This requirement is in place because high levels of these parameters are known to compromise OSS operation and treatment and may lead to premature failure of the dispersal component.

The recommended revisions will protect public health and the environment by providing parameters for designers and LHJs in ensuring that designed treatment levels meet the intent of the rule that only residential sewage effluent quality is discharged to the OSS dispersal component.

From a prior conversation with the ORRC, we asked the Technical Advisory Group (TAG) to research and review the topic regarding the maximum levels for residential sewage quality. The TAG established **maximum levels for septic tank effluent** and made a recommendation to DOH of the following:

$CBOD_5$	228 mg/L
TSS	80 mg/L
O&G	20 mg/L

These parameters are proposed as the maximum levels for residential sewage quality. Anything exceeding these parameters is considered nonresidential sewage quality, and should be treated to attain levels not exceeding these values.

These maximums were determined by the TAG to be appropriate using a compilation of various reports (see below).

*Also give consideration to a discussion to establish maximum levels for residential sewage influent.

*Also give consideration to changing TL E to the parameters established from this issue paper.

Recommended Rule Language

Blue = Additions ~~Red~~ = Deletions

WAC 246-272A-0010 Definitions.

"Residential sewage" means sewage having the constituency and ~~strength~~ quality typical of ~~wastewater~~ sewage from ~~domestic households~~ a single family residence. To be considered single family residential septic tank effluent quality, the ~~will have maximum~~ levels of CBOD5, TSS and O&G must not exceed the following: ~~as follows:~~ $CBOD_5$ – 228 mg/L, TSS – 80 mg/L, and O&G – 20 mg/L.

WAC 246-272A-0230 Design requirements—General.

(2) (e) (ii) For OSS treating sewage from a nonresidential source, the designer shall provide the following information:

(A) Information to show the sewage is not industrial wastewater;

(B) Information regarding the sewage effluent quality and identifying chemicals found in the sewage effluent that are not found in sewage effluent from a residential source; and

(C) A site-specific design providing the necessary treatment ~~level equal~~ to equal that required of sewage effluent quality from a single family residential source;

Supplemental Information from DOH

Water Environment Research Foundation (2009). *Influent Constituent Characteristics Of The Modern Waste Stream From Single Sources.* IWA Publishing

Water Environment Research Foundation (2007). *Influent Constituent Characteristics Of The Modern Waste Stream From Single Sources.* IWA Publishing

Washington Department of Health (2004). Rule Development Committee Issue Research Report Draft: Septic Tank Values.

337-105.pdf

Excerpts from the 2009 WERF report:

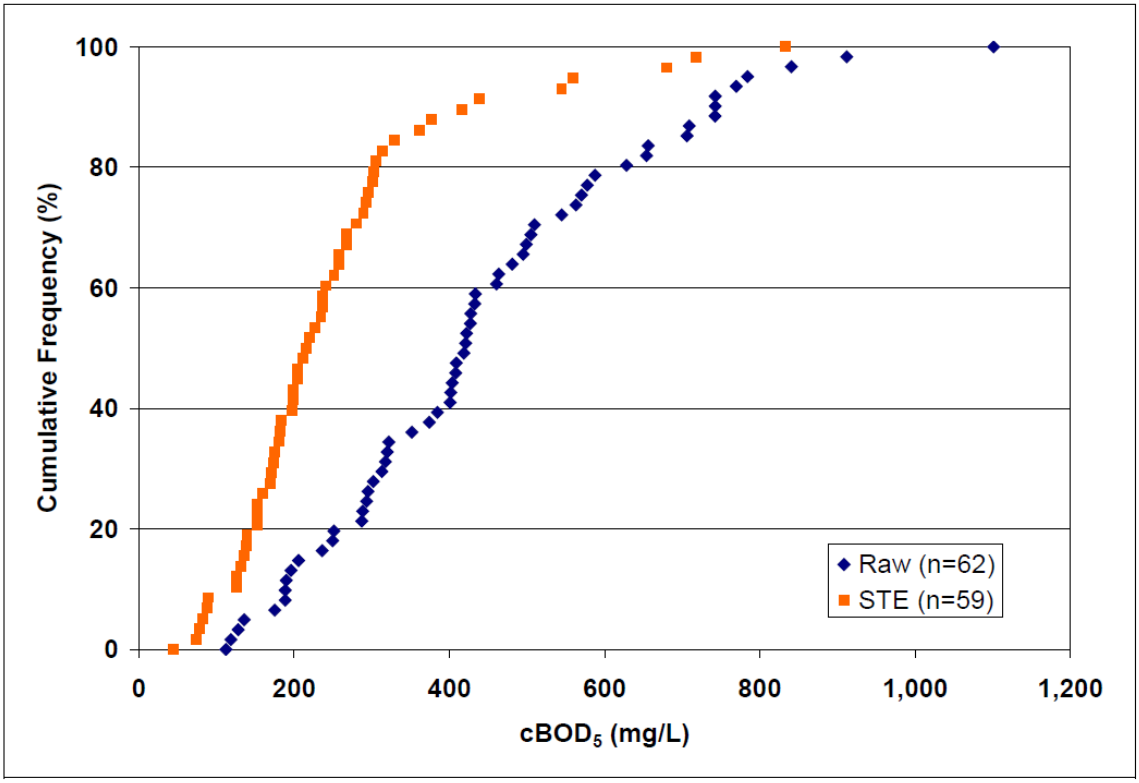

Figure 3-11. $cBOD_5$ in Raw Wastewater and STE.

The cBOD5 in raw wastewater ranged from 112 to 1,101 mg/L, with an average of 443 mg/L and a median value of 420 mg/L. This is higher than the median value found in the literature review (343 mg/L), but similar to that cited by Crites and Tchobanoglous (1998) (450 mg/L). The range of cBOD5 in STE was found to be 44-833 mg/L, with an average of 252 mg/L and a median value of 216 mg/L. Similar to raw wastewater this is higher than previously reported in the literature, where the median value was found to be 156 mg/L. By comparing the median values for raw wastewater and STE, 49% removal of cBOD5 within the septic tank was observed in this study. This removal is on the upper end of the typical BOD removal range of 30- 50% reported in U.S. EPA 2002. Of note, the concentrations in raw wastewater poorly correlate with STE concentrations (see Section 4.4). Figure 3-11 illustrates the range of cBOD5 values in both raw wastewater and STE.

Figure 3-10. TSS in Raw Wastewater and STE.

Although the range of TSS in raw wastewater was quite large (22-1,690 mg/L), 80% of all values were below 400 mg/L (Figure 3-10). The median TSS concentration in raw wastewater was 232 mg/L. The literature review showed a range of TSS values in the raw wastewater from 23 to 2,233 mg/L, with 90% of all values less than 602 mg/L.

Compared to raw wastewater, little TSS variability was observed in STE concentrations. The median TSS concentration was 61 mg/L, with an IQR between 49 and 84 mg/L. This IQR is within the range of 22 to 276 mg/L reported in the literature. The small variability of TSS in the STE suggests that the tank is a reliable approach for reduction of TS and TSS in wastewater.

Table 3-7. Summary of Tier 1 Constituents from This Study and Previously Reported (in mg/L).

		This Study			U.S. EPA (2002)	Crites and Tchobanoglous (1998)
		Median	Range[1]	Lit. Review		
Alkalinity (as $CaCO_3$)	Raw	260	65 – 575	NR	NR	NR
	STE	411	172 – 862	NR	NR	60 – 120
TS	Raw	1,028	252 – 3,320	NR	500 – 880	350 – 1,200
	STE	623	290 – 3,665	NR	NR	NR
TSS	Raw	232	22 – 1,690	18 – 2,230	155 – 330	100 – 350
	STE	61	28 – 192	22 – 276	50 – 100	40 – 140
$cBOD_5$	Raw	420	112 – 1,101	30 – 1,147	155 – 286	110 – 400
	STE	216	44 – 833	38 – 861	140 – 200	150 – 250
COD	Raw	849	139 – 4,584	540 – 2,404	500 – 660	250 – 1,000
	STE	389	201 – 944	157 – 1,931	NR	250 – 500
TOC	Raw	184	35 – 738	NR	NR	80 – 290
	STE	105	50 – 243	NR	31 – 68	NR
DOC	Raw	110	29 – 679	NR	NR	NR
	STE	66	22 – 140	NR	NR	NR
Total nitrogen	Raw	60	9 – 240	44 – 189	26 – 75	20 – 85
	STE	63	27 – 119	26 – 124	40 – 100	NR
TKN (as N)	Raw	57	16 – 248	43 – 124	NR	NR
	STE	60	33 – 171	27 – 94	19 – 53	50 – 90
Ammonium-nitrogen (as N)	Raw	14	2 – 94	9 – 154	4 – 13	12 – 50
	STE	53	25 – 112	0 – 96	NR	30 – 50
Nitrate-nitrogen (as N)	Raw	1.9	BDL – 9	0.05 – 1.1	<1	0
	STE	0.7	BDL – 7	0 – 10.3	0.01 – 0.16	NR
Total phosphorus	Raw	10.4	0.2 – 32	13 – 26	6 – 12	4 – 15
	STE	9.8	0.2 – 33	3 – 40	7.2 – 17	12 – 20

[1] All data included, outliers were not removed
NR = not reported
BDL = below detection limits

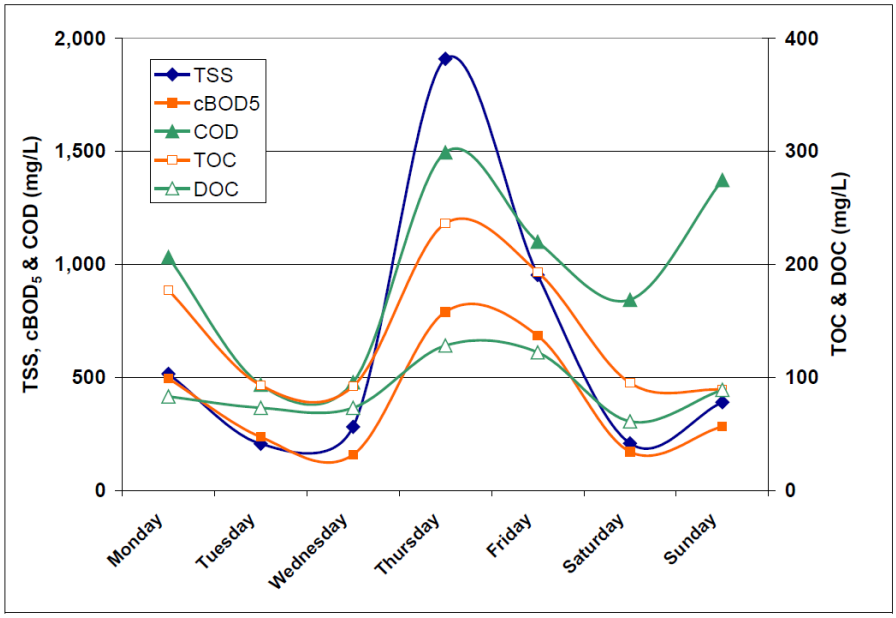

Figure 4-5. Weekly Solids and Carbon Variations in Raw Wastewater in Colorado.

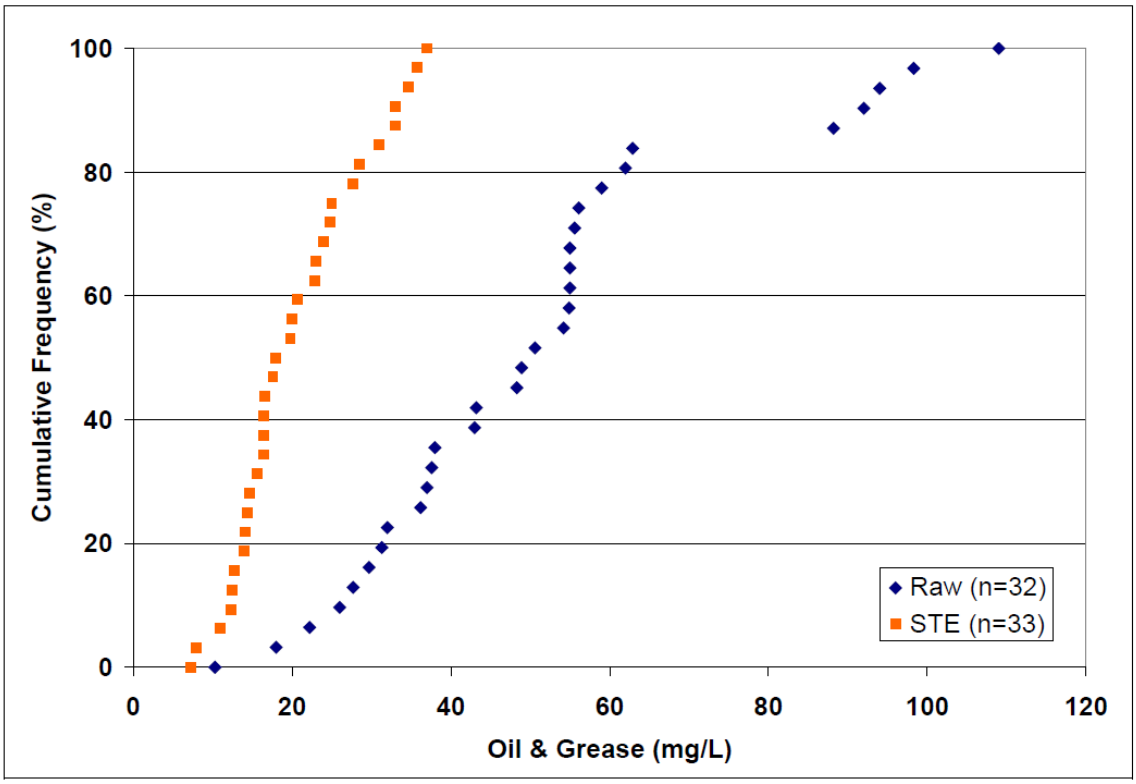

Figure 3-20. Oil and Grease in Raw Wastewater and STE.

Oil and grease in raw wastewater varied from 10 to 109 mg/L (Figure 3-20), which is slightly lower compared to the values reported in the literature review of 16 to 134 mg/L. This might be due to changing lifestyle habits (e.g. use of olive oil instead of lard for cooking), but remains unclear at this time. For STE, the oil and grease values ranged from 7 to 37 mg/L. Only two sources were found previously in the literature (31 and 32 mg/L).

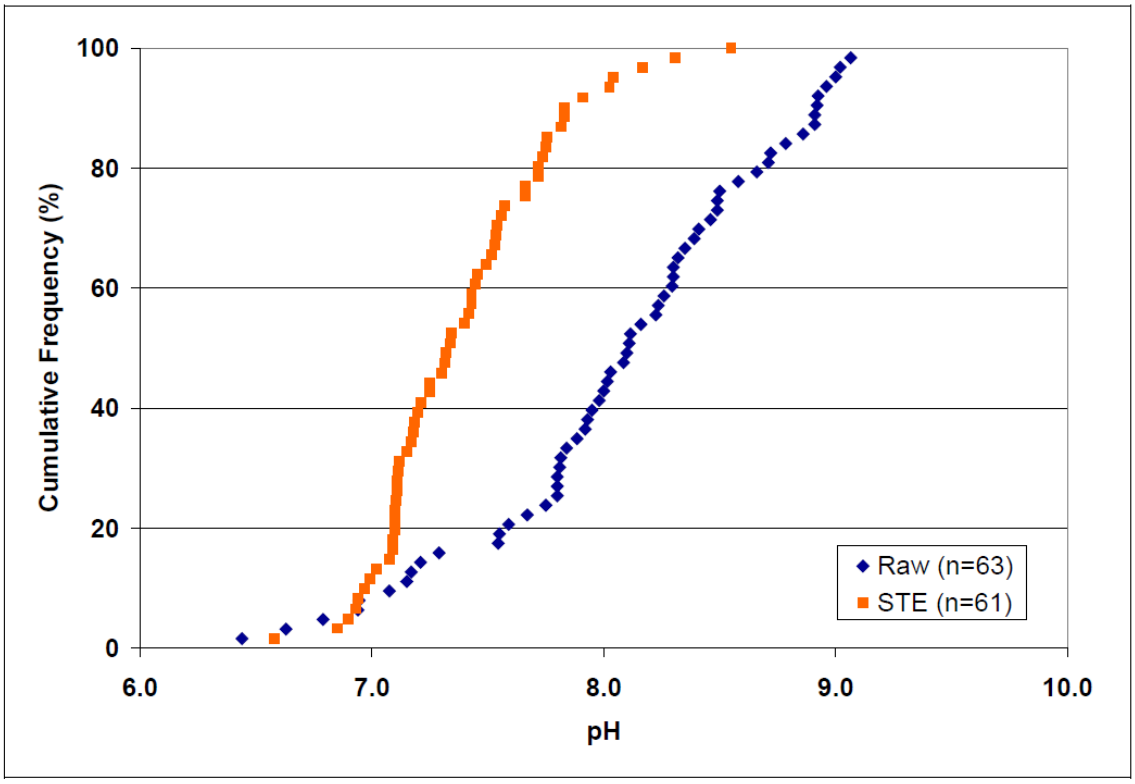

Figure 3-7. pH in Raw Wastewater and STE.

TAG Decision:

May 16, 2019, Leslie Turner, WWMS, DOH – TAG Coordinator

The WA Technical Advisory Group (TAG) recommends adopting the following parameters for Residential Strength Waste:

Septic Tank Effluent (Maximums):

CBOD5 228 mg/l

TSS 80 mg/l

O&G 20 mg/l

All of the following was submitted to the TAG for their review:

Residential vs High Strength Waste

Leslie Turner
May, 2019

WAC 246-272A Onsite Sewage Systems (OSS) allows LHJs to permit wastewater from non-residential (not industrial) if it is treated to residential strength. The rule does not define maximum values for residential strength. Waste sampling results were collected from a number of reliable results which are presented in this paper. The numbers were averaged to obtain a recommendation for Carbonaceous Biochemical Oxygen Demand ($CBOD_5$), Total Suspended Solids (TSS), and Fats, Oils and Grease (FOG or O&G) values. Nearly all of the study results were reported in BOD_5. The current rule uses $CBOD_5$ in lieu of BOD_5. To reconcile the numbers, BOD_5 results were adjusted in the tables by applying the following conversion: $CBOD_5 = BOD_5 \times 0.83$. WAC 246-272A-0125 (5) (c) allows test results for BOD_5 to be submitted in lieu of test results for $CBOD_5$ using a 0.83 conversion factor.

There have been many studies and a variety of values for residential versus commercial wastewater strengths collected from various states and literature regarding wastewater. An analysis of these values will hopefully lead to drawing the fine line between residential and high strength waste values for the State of WA. In this paper, several studies with conclusive numbers are compiled and compared. A set of parameter values are recommended.

A biomat is a beneficial biological layer which develops at the soil interface of the drainfield and causes the effluent movement to slow down. It provides an ideal habitat for anaerobic microorganisms that digest effluent particles. The formation of the biomat is a progressive event. This living slimy layer also restricts the flow of the effluent and its infiltration rate into the unsaturated soil which is commonly referred to as the vadose zone. If equilibrium between the biomat and soil interface are not achieved the biomat layer becomes too thick restricting wastewater flow and failure may result.

High strength wastewater has more organic matter than residential strength wastewater. Biochemical Oxygen Demand (BOD_5) is a 5 day test measuring the amount of dissolved oxygen consumed by microorganisms as they feed on the organic matter in sewage. The higher this value is, the more organic matter exists which in turn can support more microorganisms. With a high organic composition, more organisms are needed for digesting the organic matter and therefore more oxygen is needed. Greater organic matter may lead to an excessive biomass which in turn can lead to clogging of components and the biomat, and ultimately shorten the life of the OSS. The higher the BOD_5, the higher the overall strength of the wastewater.

Total Suspended Solids (TSS) are also evaluated to determine wastewater strength. The suspended solids may be organic or inorganic particles. Inorganic particles are not broken down by the biological processes. The tests for TSS may be a solids and/or a turbidity analysis. High turbidity is an indicator of high TSS. High TSS can lead to clogging devices and clogging orifices and impact the biomat.

Fats, Oils and Grease (FOG or O&G) are evaluated to determine wastewater strength. These constituents do not break down easily. Fats and oils may be made up of animal fats, vegetable oils and other cooking shortening. Grease comes from body lotions, laundry detergent, shampoos, dead microorganisms, etc. They are lighter and less dense than water and float to the top of the septic tank and grease traps. The accumulation of FOG is typically called the "scum" layer in a septic tank. High amounts of FOG can accumulate in the pipes and the biomat and lead to clogging, interfering with aerobic treatment processes and cause a decrease in the treatment efficiency.

Besides the 5 day Biochemical Oxygen Demand test, there is a 5 day Carbonaceous Biochemical Oxygen Demand ($CBOD_5$) test also used to analyze the microorganism mass. A nitrogen inhibitor is added to the $CBOD_5$ to lower the oxidation of carbonaceous matter. With lower oxidation, there are fewer bacteria so the $CBOD_5$ is less than BOD_5. The BOD_5 should be higher than the $CBOD_5$ by approximately 15 - 20 %. (Muirhead et al.)

FOG state at room temperature and toxicity levels (Lesikar, B., Stuth Sr., W., et al, 2008)

Constituent	State at Room Temperature[1]	Derived From	Comments[2]
Fats	Solid	Animal fat	Non-toxic to the system
Oils	Liquid	Vegetable and cooking oils	Non-toxic to the system
Grease	Liquid	Petroleum based products: soaps, hair conditioners, tanning oils, oil/grease on hands/ clothes, bath oils, etc.	Residual material on appliances; solid material attached to pans/ equipment; may potentially be toxic to microbes commonly present in the wastewater treatment system.

[1] Room temperature assumes 80°F.
[2] Warning: the use of a degreaser will move all of these components through the wastewater system.

Treatment of commercial waste containing FOG such as from a food service can lack enough oxygen to break down the FOG and the pH may not be high enough for the microorganisms' survival. This may lead to pipe and drainfield clogging.

In this paper, all BOD_5 values were converted to $CBOD_5$ by a factor of 0.83. Unless from the study, average values are the range of measured values divided by two. The recommended values are the sum of all of the averages below divided by the number of averages. In effluent values, all strengths were included, with or without effluent filters, and with or without food grinders were all added into the average total.

Section 1
Residential Strength Wastewater

Residential strength waste effluent (Stuth and Wecker)

$CBOD_5$ mg/L	**TSS** mg/L	**O&G** mg/L
108 – 144	47-62	10 – 20
Average 126	**Average** 55	**Average** 15

Stuth, William L, 2003

Typical residential waste strength values

Parameter	Range	Typical
BOD_5	110 to 250 mg/l	140 mg/l
TSS	20 to 155 mg/l	40 mg/l
FOG	10 to 20 mg/l	15 mg/l
DO	0 to 1.0 mg/l	0.5 mg/l
pH	6.5 to 7.2	7.0

Note: BOD5 110 to 250 mg/l = 91 $CBOD_5$ to 208 mg/l. Typical BOD_5 mg/L = 116 $CBOD_5$.

Effluent values of residential septic tank with and without an effluent filter, mg/L

Crites and Tchobanoglous

With garbage disposal and w/o effluent filter Mg/L		**With garbage disposal and effluent filter Mg/L**	
$CBOD_5$	**RANGE**	**$CBOD_5$**	**RANGE**
158	100 - 140	116	83 - 116
TSS	**RANGE**	**TSS**	
85	40- 140	30	20 - 55
O&G	**RANGE**	**O&G**	**RANGE**
30	20 - 50	20	10 - 20

Untreated domestic wastewater in mg/L Metcalf & Eddy, Inc. 1991

	$CBOD_5$	**TSS**	**O&G**
Weak	93	100	50
Medium	183	220	100
Strong	332	350	150

Untreated domestic wastewater in mg/L Metcalf & Eddy, Inc. 2003

	$CBOD_5$	**TSS**	**O&G**
Weak	91	120	50
Medium	158	210	90

Strong	291	400	100

Crites and Tchobanoglous 1998.

$CBOD_5$	**TSS**	**O&G**
	95	31

Gunn 2014

Raw sewage characteristics

$CBOD_5$	**TSS**	**O&G**
120 - 237	155 - 330	
Average 179	**Average** 320	

Gunn

Septic tank effluent

$CBOD_5$	**TSS**	**O&G**
98 - 157	36 - 85	
Average 177	**Average** 79	

CIDWT glossary

Residential Wastewater definition; from septic tank or treatment device	**$CBOD_5$ Mg/L**	**TSS Mg/L**	**FOG Mg/L**
Less than or equal to	141	60	25

2004 High Strength Waste Values by State (SORA)

State	**$CBOD_5$ Mg/L**	**TSS Mg/L**	**FOG Mg/L**
Montana	249	150	25
New Mexico, with effluent filter	150	60	
North Carolina monthly average Maximum values	 200 300	 75 150	 30 50
Virginia	200	150	30
Ohio	250	150	25
Minnesota	220	65	30
Oregon	300	150	25
Utah	250	145	25
Wisconsin	220	150	30

State		**$CBOD_5$ Mg/L**	**TSS Mg/L**	**FOG Mg/L**
Arkansas		>249	>300	>25
Colorado	Influent	>249	>200	>50
	Effluent	>149	>80	>25
Connecticut	Low	<191	<150	<25
	Weak	91		
	Medium	183		
	Strong	332		
Idaho		129 - 232	155-330	70-105
Ohio		208	330	25
Minnesota	Influent	249	200	50
	Effluent	141	60	25
Oregon	Effluent	249	150	25
Utah	Effluent	183	145	25
Wisconsin	Influent Monthly Average	183	150	30
WA	TL E	125	80	20
WERF 2009	Influent	450	334	50
	Effluent	268	68	19

Residential WW

Reference	**$CBOD_5$ Mg/L**	**TSS Mg/L**	**FOG Mg/L**
EPA (2002)	129 – 238	155 – 330	70 – 105
Average	248	320	88
Crites and w/out effl. Filter	125 - 208	40-140	20-50
Tchobanoglous Average	167	110	45
1998			
with effl. Filter	83 -116	20-55	10-20
Average	141	48	15
Lesikar, Stuth, et al. (2008)			
Raw High Strength WW	>249	>200	>50
High Strength STE	>141	>60	>25
Burks & Minns (1994)			
Raw	83 – 332	100-400	50 – 150
Typical	208	220	100
Tchobanoglous (1991) **Raw** WW			
Weak	91	100	50
Medium	183	220	100
Strong	332	350	150
Goldstein and Moberg			
Suggested $CBOD_5$ for restaurants (used as upper limit for residential)	374		
Stuth, William, L. (2003) Typical Residential waste strength			
Range	91 – 208	20 – 155	10 – 20
Average	116	98	15

Water Environment Research Foundation (WERF) conducted a comprehensive field study through the Colorado School of Mines, measuring several parameters of residential influent and effluent. The collection of data was 2007 to 2008.

- The study looked at 3 regions in the US
  - Midwest/Northeast = Minnesota
  - South = Florida
  - West = Colorado
- 68 sites (with data)
- Systems were under 25 years old with concrete chambered septic tanks serving 2 to 6 occupants varying in age from small children to seniors.
- 24 hour composite samples were collected from the Influent and effluent
- The sites were monitored in the fall 2007, winter 2007, spring 2008, and s55ummer 2008.
- The Hydraulic Retention Time (HRT) is estimated based on daily flow and the reported tank size

WERF Averages:

Septic Tank Influent	**$CBOD_5$ Mg/L**	**TSS Mg/L**	**FOG Mg/L**
Average	419	335	From 34 Sites 326

Septic Tank Effluent	**$CBOD_5$ Mg/L**	**TSS Mg/L**	**FOG Mg/L**
Average	228	63	From 34 Sites 21

Please see attached charts

Section 2
Commercial, high strength wastewater

Facilities that typically generate high strength waste:

- **Restaurants**
- **Laundromats**
- **Catering / Banquet / food services**
- **Nursing Homes**
- **Supermarket / meat cutting**
- **Bakery / deli**
- **Schools**
- **Youth Camps**
- **Coffee / Espresso stands**
- **RV Parks / wet sewer**
- **RV dumps / boat pump-out**
- **Farm worker camps**

CIDWT glossary

High Strength Wastewater definition	**$CBOD_5$ Mg/L**	**TSS Mg/L**	**FOG Mg/L**
Influent	>249	>200	<50
Effluent From a septic tank or other pretreatment component	>141	>60	>25

High Strength Wastewater Literature Review by Sara F. Hager

	$CBOD_5$ Mg/L	**TSS Mg/L**	**FOG Mg/L**
Range	83 – 3059	142 – 4375	50 – 14,958
Average	3100	2330	7504
Median in the high to mid strength entering ST or grease trap	2075	1200	300

- Please see attached charts for Grant County Yearly Septic Reports for miscellaneous commercial facilities for 2013 through 2018

STE from various commercial establishments

Siegrist et al., 1985 STE	**$CBOD_5$ Mg/L**	**TSS Mg/L**	**FOG Mg/L**
Restaurant A	483	187	101
Restaurant B	203	65	40
Restaurant C	730	372	144
Restaurant D	313	247	101
Restaurant E	575	125	65
Restaurant F	217	66	47
Motel	142	66	45
Country Club A	164	56	24
Country Club B	276	121	46
Country Club C	84	44	33

Bar/Grill	149	79	49

Chen, X et al. 2000

Restaurant Wastewater	**$CBOD_5$ Mg/L**	**TSS Mg/L**	**FOG Mg/L**
Chinese	48 – 1187	13.2 – 246	120 – 172
Average	618	130	146
Western	406 – 1170	152 – 545	52.6 – 2100
Average	788	349	1076
American	336 – 1859	68 – 345	158 – 799
Average	1098	241	558
Student Canteen	452 – 1353	124 – 1320	415 – 1970
Average	903	784	1400
Bistro	374 – 584	359 – 567	140 – 410
Average	665	643	345

Hammerlund, D., Glotfelty, B.

Commercial Septic Tank Effluent Quality

	BOD5	COD	TSS	TKN	NO3	TP	FOG
MEAN	888	1206	132	69	<0.2	18.5	182
MEDIAN	626	1090	90	60	<0.2	---	67
MIN.	155	170	10	29	<0.2	16.9	13
MAX.	2951	2888	642	127	1.4	20	814
#of Samples	26	27	27	26	15	2	8

All Sample Results are in milligrams per liter (mg/l)

(Samples collected from 13 sites in Maryland)

The average $CBOD_5$ = 737 mg/L

PARKS RV **dump** sampling data

samples taken in 1998 at 33 parks

	(Influent) Parameter					
	pH	COD	BOD	TSS	NH_4	FOG
Average	**7.16**	**7815**	**5042**	**5215**	**786**	**682**
Maximum	8.5	32300	24,300	31, 330	1110	2910
Minimum	6.69	1620	520	152	542	11
Median	7.07	4180	2875	1570	822	330

	(Effluent) Parameter					
	pH	COD	BOD	TSS	NH_4	FOG
Average	**7.27**	**2961**	**2743**	**1560**	**526**	**306**
Maximum	7.70	8820	21330	24400	919	2190
Minimum	7.09	271	138	68	140	21
Median	7.20	3110	2140	374	580	84

from: 1999 PARKS Report: "RV Waste Treatment Facilities Assessment" - Moore & Gerst

Average Influent $CBOD_5$ = 20,169 mg/L

Average Effluent $CBOD_5$ = 17,704 mg/L

Conclusion and Recommendations

Parameter values for both influent and effluent residential vary greatly. Parameter values for both influent and effluent commercial facilities vary greatly.

The average of all values for residential effluent are:

Septic Tank Influent	**$CBOD_5$ Mg/L**	**TSS Mg/L**	**FOG Mg/L**
Average	227	223	96
Recommended	230	225	95

Septic Tank Effluent	**$CBOD_5$ Mg/L**	**TSS Mg/L**	**FOG Mg/L**
Average	222	95	29
Recommended	220	95	25

Appendix A

Original Charts in BOD_5

Residential Septic Tank Effluent Values (mg/L)

	EPA[1]	DOH[2]	Stuth[3]	TLE[4]
BOD_5	160	100	140	125*
TSS	100	37	40	80
O&G	37	15	15**	20

[1]EPA Onsite Manual 2002 - 5 study averages

[2]DOH Waste Strength Technical Paper (with eff. filter)

[3]Residential Wastewater Profiles, Stuth 2003

[4]WAC 246-272A (treatment compliance standard)

*($CBOD_5$) **FOG

2018 High Strength Waste Values by State (SORA)

State		**BOD_5 Mg/L**	**TSS Mg/L**	**FOG Mg/L**
Arkansas		300	300	25
Colorado	**Influent**	300	200	50
	Effluent	180	80	25
Connecticut	Low	230	150	25
	Weak	110		
	Medium	220		
	Strong	400		

Idaho Average	155-280 218	155-330 243	70-105 88
Ohio	250	330	25
Minnesota **Influent** Effluent	300 170	200 60	50 25
Oregon Effluent	300	150	25
Utah Effluent	250	145	25
Wisconsin **Influen**t Monthly Average	220	150	30
WA TL E	$CBOD_5$ 125	80	20

Table 4-12. Average septic tank effluent concentrations of selected parameters from various commercial establishments[a]

Wastewater Type	BOD_5 (mg/L)	COD (mg/L)	TSS (mg/L)	TKN (mgN/L)	TP (mgP/L)	Oil/Grease (mg/L)	Temp (°C)	pH
Restaurant A	582	1196	187	82	24	101	8–22	5.6–6.4
Restaurant B	245	622	65	64	14	40	8–22	6.6–7.0
Restaurant C	880	1667	372	71	23	144	13–23	5.8–6.3
Restaurant D	377	772	247	30	15	101	16–21	5.7–6.8
Restaurant E	693	1321	125	78	28	65	4–26	5.5–6.9
Restaurant F	261	586	66	73	19	47	7–25	5.8–7.0
Motel	171	381	66	34	20	45	20–28	6.5–7.1
Country Club A	197	416	56	36	13	24	6–20	6.5–6.8
Country Club B	333	620	121	63	17	46	13–26	6.2–6.8
Country Club C	101	227	44	36	10	33	10–23	6.2–7.4
Bar/Grill	179	449	79	61	7	49	8–22	6.0–7.0

[a] Averages based on 2 to 9 grab samples depending on the parameter taken between March and September 1983.
Source: Siegrist et al., 1985.

Wastewater parameter	Lesikar, et. al Study AUG 2006
BOD_5 (mg/L)	1523
TSS (mg/L)	664
FOG (mg/L)	197
Flow	96 (L/day-seat)

average results, 28 restaurants, 12 samples each

Table 4—Characteristics (average range of values) of restaurant wastewater

Wastewater parameter	Chinese restaurant	Western restaurant	American fast food	Student canteen	Bistro
BOD_5 (mg/L)	58 to 1430	489 to 1410	405 to 2240	545 to 1630	451 to 704
TSS (mg/L)	13.2 to 246	152 to 545	68 to 345	124 to 1320	359 to 567
FOG (mg/L)	120 to 172	52.6 to 2100	158 to 799	415 to 1970	140 to 410

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Raw wastewater

PARKS RV **dump** sampling data

samples taken in 1998 at 33 parks

	(Influent) Parameter					
	pH	COD	BOD	TSS	NH_4	FOG
Average	**7.16**	**7815**	**5042**	**5215**	**786**	**682**
Maximum	8.5	32300	24,300	31, 330	1110	2910
Minimum	6.69	1620	520	152	542	11
Median	7.07	4180	2875	1570	822	330

	(Effluent) Parameter					
	pH	COD	BOD	TSS	NH_4	FOG
Average	**7.27**	**2961**	**2743**	**1560**	**526**	**306**
Maximum	7.70	8820	21330	24400	919	2190
Minimum	7.09	271	138	68	140	21
Median	7.20	3110	2140	374	580	84

from: 1999 PARKS Report: "RV Waste Treatment Facilities Assessment" - Moore & Gerst

Appendix B

Grant Co and WERF charts


2016 grant county numbers.xlsx


WERF Raw WW.pdf


WERF STE.pdf

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